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ABSTRACT

Applying technology to teaching and learning has given rise to many questions which this author here attempts to identify and label. These questions come under seven headings: objectives, criteria and evaluation; characteristics of individual learners; instructional components and instructional design; use of devices; support for instructional research and development; privacy, and copyright and publication. The implication is that, if these questions are satisfactorily answered, the role of technology in education will be vastly improved. (Author/GO)

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Major Areas of Emphasis for Instructional Engineering

by Russell W. Burris*

A major concomitant of introducing technology into teaching and learning situations has been the exposure of many difficult and sometimes painful questions about the processes of learning and the practices of teaching. This paper attempts to identify and label several areas from which these questions seem to arise. These areas represent the writer's views and interpretations and to the degree that they are personal and subject to bias they may be faulted; they are based, however, on several years of experience working with faculty and students in many units of the University of Minnesota on instructional design and development projects, with other colleges and universities as a consultant for the development of teaching and learning resources and with several regional and national groups and agencies concerned with developing instructional systems and resources. It needs to be stressed, however, that these problem areas are interrelated and are in fact sub-areas of the general problem of instructional engineering.

1. Objectives, Criteria and Evaluation

Many references in current literature clearly indicate an expected use of technology to improve teaching and learning; optimal design, however, is at this juncture indefinable because of the lack of well-formulated objectives, adequate criteria and appropriate and powerful evaluation techniques.

It is rapidly becoming possible to do anything for or with students that one wants to do. Further, it is possible to keep a complete record of every move of the instructor and student through the course of doing so. But such power suddenly exposes our inadequacies. It has not been enough to tell an

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educator that his instruction should have objectives, that the content and structure of a course should be determined with reference to the objectives and that the course should be evaluated in the light of achievement of the objectives. Most of this guidance has been metaphorical. There has been little clear meaning to the "structure of a course" and the actual evaluation of objectives has been only weakly appropriate. The relations of objectives to particular steps taken in the pursuit of a course have always been problematical.

The writer feels that research efforts must be directed toward establishing a firm theoretical basis for use of instructional technology rather than the mere putting together of instructional components with old teaching-learning models. Two major questions must guide these research efforts. The first is: What is it that the student knows when one is willing to say that the student has mastered a given learning task at some appropriate level? This is the basic problem of describing what it is to "understand" a subject matter, "know" a language, to be able to "do" a skill, etc. The second question is inexorably intertwined with the first: How can one assess what it is that the student knows? If one can describe the subject matter effectively, the next step is specifying the status of the student with respect to that description. Such measurement needs to be doubly diagnostic for the purposes of systematically developing instructional technology. It must describe the learner's state of knowledge and it must specify his advancements in such detail that it can be used to evaluate the success of procedures, programs, experiences and the like which have been manipulated to achieve changes in his states.

In summary this research effort must be directed in three major problem areas: (1) the development of adequate characterizations of the subject matter in particular domains of knowledge; (2) the devising of techniques for describing

and evaluating the state of knowledge of a learner vis-a-vis a subject matter; (3) the development of models of the learning process that permit an optimal sequencing of events in instruction.

2. Characteristics of Individual Learners

Some current data seem to suggest that certain learning strategies may be appropriate for one learner and not for another. Several questions arise from present interpretations of these data. Many questionable practices occur in education as a result of limited understanding of the implications of individual differences for instructional practice. Our current understanding of individual differences does not permit answers to the following questions: (1) Are there different preferred learning strategies among individual learners? (2) Is there evidence of a relationship between such preferences and individual capacities? (3) Are these differences a result of "set" or of deeper aspects of individual behavior structure? (4) How do these individual behavior differences relate across the different kinds or categories of learning? (5) Can a learner's preferred strategy be changed to another strategy without losing, and perhaps gaining learning effectiveness and efficiency?

3. Instructional Components and Instructional Design

The major issues in this area have to do with the research and developmental efforts required to identify the critical characteristics of specific teaching-learning situations. It is not enough merely to specify a sequence of components in a teaching-learning situation. It is necessary that the components, i.e., the procedures, practices, experiences, be understood as the environments in which learning occurs. As the processes of learning are better understood there is a need to study the critical variables in lectures, discussions, laboratories, tutorials, text and reference reading, etc. as they relate to learning.

This writer has studied current instructional practice at the undergraduate level, and the data show that approximately 80 percent of instructional design at that level can be accounted for by lecture, instructor-led discussion and textbook assignments. This suggests that the components used in instructional design are based upon traditional models. However, to imply that enough is known about the critical features of each component so that selection of appropriate components for particular kinds of learning and for particular kinds of learners would be false, if not dangerous, at this time. What is needed is a heavily supported research program across the basic to applied (or field) spectrum which identifies the critical features of the learning environment as they relate to characteristics of individual learners.

Clearly, more flexible approaches to the design of learning and teaching situations are needed if the often stated goals of developing individual intellectual initiative and of aiding the student to develop skills for continuing intellectual pursuits after graduation are to be realized. Learning experiences are probably desirable in independent study, group (including student-led) study, tutorial, seminar, as well as lecture, discussion and laboratory environments. Continual effort must be directed toward the selection of the components in instructional designs appropriate to both the content to be learned and the manner in which it should be learned.

In summary, the major problems in the design of instruction cannot be solved in ignorance of the processes of learning, and the critical aspects of instructional components must be related to what the learner is to learn.

4. The Use of Devices

The evaluation of devices in instructional situations can be done only after a better understanding is reached of the structure and processes of learning

and the critical characteristics of the components used in designing teaching-learning situations. Optimal uses of information resources, new techniques and equipment in the learning and teaching programs require aid and support beyond that which can be expected from specialists associated with the library, television, audio-visual and computer fields. Students and faculty are faced with complexities as they approach the new and developing technologies beyond those which specialists in particular areas can help solve. These complexities have to do with questions of why and how the resources can be best used to meet instructional objectives and learning expectations. The responsibilities associated with using devices as media for the instructional components also include evaluations of learning and teaching. Magnifying the exposure of a lecturer to a greater number of students, using a programmed instruction unit in the course of instruction, and simulating a problem for the student to solve at a computer terminal can be evaluated only in terms of the effectiveness these components have in the total instructional design.

5. The Support of Instructional Research and Development

Data gathered by this writer indicate that more than half the faculty in higher education feel that adequate support for instructional improvement is not available. Further, about the same number of faculty state that no one is really interested in evaluating the quality of instruction. These two observations give some hint about the difficult problem of providing support for instructional research and development. This writer's interpretation of the current support programs is that many features are lacking for achieving success.

Instructional improvement must be a higher order goal within the educational institutions and within the disciplines. This must be the case in order to enlist the support of the most respected members of the various disciplines who

are also the most respected faculty members of the major institutions. However, this goal is next to meaningless unless the criteria of improvement are meaningful and shared and unless the methods and outcomes of evaluation are seriously developed and applied by all those in significant positions within the institutions and disciplines.

This writer believes that only large scale efforts are apt to be successful in applying instructional technology for instructional improvement. A model which comes to mind is the Co-operative Research Programs in agriculture. The present basic and field research and development problems in education have similarities to such problems in agriculture at the beginning of this century. The need for major programs based and coordinated at large universities and the need for the participation of many scientific research specialists and technologists seem obvious. Further, the research and developmental efforts at universities must have formal ties to the field applications.

6. Privacy

A major part of developing instructional systems is use of data banks in which the response data of an individual's educational history are stored, from pre-school through college and possibly beyond. While there is evidence for the value of this information in the design of instruction for the individual, the fact that this information exists in machine memory has rather serious implications.

7. Copyright and Publication

If the major publishing houses and other newly formed industries related to instruction are serious about their future roles as suppliers and distributors of instructional materials, they must take an active part with educators and government in solving problems having to do with copyright, rights of authors

and developers, use of microforms and computers, and instructional system packages. There is evidence that many decisions being made in some of the businesses ignore current state of the art positions and developmental trends that are fairly obvious.